Cotton Fibers Creep Behavior: Viscoelastic Modelling and Bundles Friction

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INTRODUCTION

Fiber mechanical properties is one of the key properties of cotton and has important influences on yarn production and yarn quality. Various tests have been developed to characterize cotton fiber behavior. This study was carried out to investigate the effects of the tensile and creep tests on bundles. Analogical models with different fiber parameters were studied for predicting a general model valuable for every different cotton fiber variety.

APPROACH

The time-dependent behavior of cotton fibers may be studied by conducting tensile and creep experiments. The aim of the whole research is to discuss the basic concepts of viscoelastic behavior of cotton fibers as well as modeling the creep response. The inter-fiber friction is also studied as far as it is a very important component.
Four cotton fibers varieties have been studied in both single and bundle. Prior to testing, all cotton samples were conditioned for at least 48 hours in standard conditions (HR% = 65±4%, T = 20±2°C).

RESULTS AND DISCUSSIONS

Cotton is viscoelastic. Viscoelasticity is the property of materials that exhibit both viscous and elastic characteristics when undergoing deformation. Cotton fibers response to creep test have been modelled to a dashpot (Part1 in fig.1: representing the viscous element η_1) in series with a kelvin voigt model (Part2 in Fig.1: in which a spring (representing the elastic element E) and a dashpot (representing the viscous element η_2) are connected in parallel).

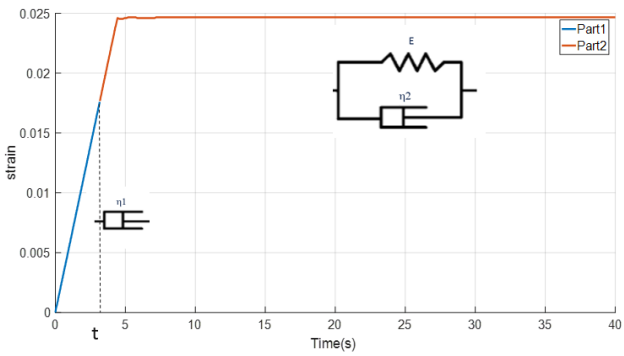

Figure.1 Bundle cotton fiber creep result

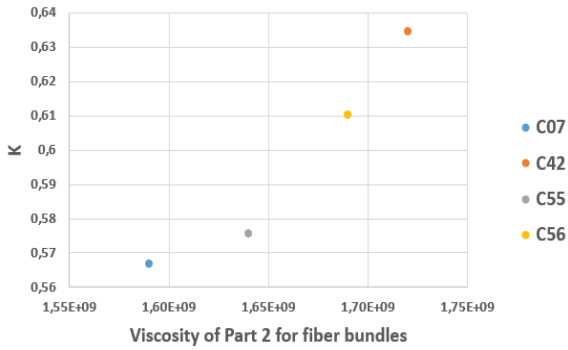

Figure.2 Friction coefficient K vs. η_2

In this research, both single and bundles testing methods have been used. The Four different varieties of cotton fibers studied are named C07, C42, C55 and C56. They have different physical properties (such as; maturity, fineness, micronaire, length, tenacity etc.). We conduct that the difference in the physical properties influences the mechanical one, which are determined form the creep tests, is related to the inter-fiber friction (the friction component K). We conduct also that the inter-fiber friction is in the origin of the difference between the second part viscosity (η_2).

CONCLUSION

The relationship between fibers and yarn structure taking in account the inter-fiber friction is, in a part, a perspective of our research. Now, analogical models for both single and bundle cotton fibers have made a big advance in understanding cotton's viscoelastic behavior as well as the influence of the mechanical parameters.